DESCRIPTION

DELIVERY DEVICE AND CONTAINER PROVIDED WITH THE SAME

TECHNICAL FIELD

The present invention relates to a delivery device that delivers a liquid contained in a flexible container when the container is depressed, and the container provided with the delivery device.

BACKGROUND ART

A container used to drip a liquid contained therein such as eye dropper employs a delivery device 150 such as one shown in Fig. 41(a), (b). The delivery device 150 is fitted at a mouth 152a of a container body 152, having an outlet orifice 151 of which inner diameter is set so as to allow it to deliver the liquid by depressing the container body 152 and keep the liquid from being delivered when the container body 152 is not depressed, and an outlet opening 153 of which a dimension is set so as to hold the liquid in the form of a drop 154.

The container as shown in Fig. 41 has a high possibility of the outlet opening 153 being contaminated by microorganisms such as bacteria and dust. In the case of an eye dropper, in particular, it is very likely that the outlet opening 153 catches microorganisms through contact with cornea and/or eye lid. After delivering the liquid from the container, outside air is taken

in through the outlet opening 153 so as to restore the container body 152, that has been deformed by depressing, into the original shape, during which microorganisms and dust that have been caught on the outlet opening 153 may be carried by the liquid (ophthalmic solution) 155 that has remained in the outlet opening 153 and returns into the container body 152, as shown in Fig. 42 (a), (b). Reference numeral 156 in Fig. 42 (b) denotes bubbles in the liquid (ophthalmic solution) 155.

Since entry of microorganisms and dust into the container body may cause the liquid contained therein to degenerate or deteriorate, the ophthalmic solution contained in the eye dropper includes antiseptic agent such as benzalkonium chloride or paraben mixed therein. However, there are such problems that it is difficult to prescribe a composition that includes an antiseptic depending on the type of ophthalmic solution, and the antiseptic may cause a side effect such as allergy in the user of the ophthalmic solution. For these reasons, efforts have been made to eliminate or reduce the use of antiseptics.

For example, disposable eye droppers that contain small quantity of ophthalmic solution and are sealed without antiseptic included have been commercialized for some time. Although this eye dropper can eliminate the use of aseptic agent, high cost limits the applications thereof and prohibits wider applications.

Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2002-80055 discloses a delivery device provided

with a filter that employs the so-called delamination bottle having an outer layer and an inner layer which is provided delaminatably on the inside of the outer layer. Since this delivery device prevents the outside air from flowing into the container through the outlet opening after delivering the liquid, contamination of the liquid in the container by bacteria or the like can be prevented. However, it is necessary to provide an inner container that is constituted from the inner layer and is easily deformed, so as to accommodate a change in the inside pressure of the container due to the delivery of the liquid, resulting in a high manufacturing cost of the container.

Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2001-179017 and Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2001-206454 disclose antibacterial containers with a porous filter that has pores small enough to prohibit the passage of bacteria and dust and is fitted at the outlet opening thereof. In this case, however, when the porous filter dries up after being wetted by the liquid, there is a possibility of the filter being loaded with the solute contained in the liquid. A suspension may be used as the ophthalmic solution depending on the application, in which case the problem of loaded filter becomes more likely to occur. Moreover, while the containers described in Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2001-179017 and Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No.

2001-206454 employ the porous filters made of sintered metal or sintered resin, in which case fine particles of the sintered material may be delivered along with the liquid.

DISCLOSURE OF THE INVENTION

With this background, an object of the present invention is to provide a delivery device to be fitted at the mouth of a container so as to deliver a liquid contained therein in the form of drops, that enables it to prevent the liquid from flowing backward and achieve aseptic entry of air into the container after delivering the liquid.

Another object of the present invention is to provide a container that allows it to eliminate or reduce the use of an antiseptic for the purpose of preventing the content liquid from being degenerated or deteriorated, and achieves smooth delivery of the liquid without clogging the outlet opening even when the content liquid is a suspension.

[Delivery Device]

The delivery device of the present invention that achieves the object described above comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape having an outlet orifice at the bottom thereof, a valve element made of an elastic material that, when there is no liquid pressure exerted thereon from upstream side, closes the outlet orifice and/or a flow passage communicating with the outlet orifice in

the outlet portion and, when forced by the liquid pressure from upstream side, deforms and opens the outlet orifice and/or the flow passage, and a vent hole that communicates with the outlet orifice and the flow passage which is provided at a positioning the upstream of said valve element via an air filter, with the side of said outlet orifice defined as the downstream, wherein deformation of the valve element is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice and/or the flow passage cannot be achieved by the pressure required to pass air through the air filter from outside.

In the delivery device of the present invention, the valve element that controls closure and opening of the outlet orifice and the flow passage is made of an elastic material and, when there is no liquid pressure exerted thereon from upstream side, closes the outlet orifice and/or the flow passage and, when forced by the liquid pressure from upstream side, deforms and opens the outlet orifice and/or the flow passage. When the outlet orifice and/or the flow passage is opened, the outlet orifice and the upstream side (specifically, a container body such as eye dropper connected with the delivery device of the present invention) of the outlet portion become connected to communicate with each other, thereby achieving delivery of liquid from the outlet orifice.

To achieve delivery of the liquid from the outlet orifice with the delivery device of the present invention, for example,

a pressure may be applied to the container body such as eye dropper that is connected with the delivery device. As the pressure is applied, the valve element of the delivery device receives the pressure of the content liquid (medical liquid or the like) from upstream side, so that the valve element is deformed and the outlet orifice and/or the flow passage opens. Upon completion of the delivery operation, the deformed container body draws in outside air through the vent hole in order to restore the original shape. When the delivery device of the present invention is used, since the air filter is fitted at the vent hole that communicates with the flow passage of the content liquid, aseptic entry of air into the container can be achieved after the delivery operation.

Negative pressure, that is generated in the container body connected to the delivery device so as to draw in the outside air after completing the delivery operation, has an effect of accelerating the restoration of the deformed valve element. As a result, a clearance (flow passage) formed by the delivery operation between the valve element and the outlet portion is immediately closed when the pressure on the container body is removed, and therefore the valve element in the delivery device of the present invention acts as a check valve.

The delivery device of the present invention may be embodied for example, as described below in first to fifth embodiments.

(First Embodiment)

First delivery device according to the present invention

comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape that has an outlet orifice at the bottom thereof, a valve element made of an elastic material and disposed in the outlet portion that, when there is no liquid pressure exerted thereon from upstream side, closes the outlet orifice and, when forced by the liquid pressure from upstream side, undergoes compressive deformation so as to open the outlet orifice, a locking member that is disposed in the outlet portion so as to define a flow passage between itself and the inner surface of the outlet portion and fastens the valve element in upstream position, with the outlet orifice defined as the downstream side, and a vent hole that communicates with the flow passage which is provided at a position in the upstream of said valve element via an air filter, wherein compressive deformation of the valve element is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice and/or the flow passage cannot be achieved by the pressure required to pass air through the air filter from outside.

In the first delivery device, the valve element made of an elastic material and disposed in the outlet portion operates in relation to the outlet orifice serving as a valve seat so as to control closure and opening of the flow passage. When there is no liquid pressure exerted thereon from upstream side, the valve element closes the outlet orifice and, when forced by the liquid pressure from upstream side, undergoes compressive deformation

so as to open the outlet orifice. When the outlet orifice is opened, the outlet orifice and the flow passage that is formed between the inner surface of the outlet portion and the locking member communicate with each other, thus achieving delivery of the content liquid from the outlet portion.

In the first delivery device, delivery of the liquid from the outlet orifice may be achieved by applying a pressure to the container body that is connected with the delivery device similarly to that described previously. Such features and operations are also similar to those described previously, that aseptic entry of air into the container through the air filter can be achieved when the valve element restores the original shape after the delivery operation, and that negative pressure that draws in the outside air accelerates the restoration of the deformed valve element (hence the valve element can be caused to act as a check valve).

In the first delivery device, since compressive deformation of the valve element is achieved by a liquid pressure lower than the pressure that is required to pass the liquid through the air filter, there occurs no leakage of the liquid in the air filter during the delivery operation. Moreover, since opening of the outlet orifice and/or a flow passage communicating with the outlet orifice cannot be achieved by the pressure required to pass air through the air filter from outside, there occurs no entry of the outside air through the outlet orifice instead of through the vent

hole, nor corresponding leakage of the liquid through the outlet orifice during restoration of the container body.

As a result, according to the first delivery device of the present invention, delivery operation and restoration of the container body after the delivery operation can be achieved smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust being carried by the liquid to the upstream.

In the first delivery device, the valve element and the locking member are preferably integrally formed. By integrally forming the valve element and the locking member, process of manufacturing the delivery device can be made efficient. Methods for integrally forming the valve element and the locking member include, for example, multicolor molding and insert molding.

(Second Embodiment)

Second delivery device according to the present invention comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape that has an outlet orifice at the bottom thereof, a valve seat fixed in the outlet portion, a valve element made of an elastic material in a substantially tubular shape that is fixed on the inner surface of the outlet portion and, when there is no liquid pressure exerted thereon from upstream side, is seated on the valve seat from the downstream side so as to close the flow passage connected to the outlet orifice

and, when forced by the liquid pressure from upstream side, undergoes compressive deformation so as to open a flow passage between itself and the valve seat, with the outlet orifice is defined as the downstream side, and a vent hole that communicates with the flow passage which is provided at a position in the upstream of said valve element via an air filter, wherein compressive deformation of the valve element is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice and/or the flow passage cannot be achieved by the pressure required to pass air through the air filter from outside.

In the second delivery device, the valve element made of an elastic material and disposed in the outlet portion makes a pair with the valve seat that is also disposed in the outlet portion, so as to control closure and opening of the flow passage. When there is no liquid pressure exerted thereon from upstream side, the valve element makes contact with the valve seat and closes the flow passage that connects the outlet orifice and the upstream side of the outlet portion. When forced by the liquid pressure from upstream side, the valve element undergoes compressive deformation and forms a clearance between itself and the valve seat (opens a clearance between itself and the valve seat). As the clearance is formed between the valve element and the valve seat, a flow passage is formed to communicate the upstream of the valve element and the outlet orifice, thereby achieving delivery

of the liquid from the outlet orifice.

In the second valve element, delivery of the liquid from the outlet orifice may be achieved by applying a pressure to the container body that is connected with the delivery device as described previously. Such features and operations are also similar to those described previously, that aseptic entry of air through the air filter into the container can be achieved when the valve element restores the original shape after the delivery operation, and that negative pressure that draws in the outside air accelerates the restoration of the deformed valve element (hence the valve element can be caused to act as a check valve).

In the second delivery device, since compressive deformation of the valve element is achieved by a liquid pressure lower than the pressure that is required to pass the liquid through the air filter, there occurs no leakage of the liquid through the vent hole during delivery operation. Moreover, since opening of the outlet orifice and/or a flow passage communicating with the outlet orifice cannot be achieved by the pressure required to pass air through the air filter from outside, there occurs no entry of the outside air through the outlet orifice, instead of the vent hole, nor corresponding leakage of the liquid through the outlet orifice during restoration of the container body.

As a result, according to the second delivery device of the present invention, delivery operation and restoration of the container body after the delivery operation can be achieved

smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust being carried by the liquid to the upstream.

In the second delivery device, the valve element is fixed on the inner surface of the outlet portion for the purpose of accurately closing and opening the flow passage. Accordingly, the valve element and the locking member are preferably formed integrally, but are not limited to this constitution. By integrally forming the valve element and the locking member, both the valve element and the locking member can be fixed reliably, and process of manufacturing the delivery device can be made more efficient. Methods for integrally forming the valve element and the locking member include, for example, multicolor molding and insert molding.

(Third Embodiment)

Third delivery device according to the present invention comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape that has an outlet orifice at the bottom thereof, a valve element made of an elastic material and disposed in the outlet portion that, when there is no liquid pressure exerted thereon from upstream side, closes the outlet orifice or the flow passage which communicates with the outlet orifice and, when forced by the liquid pressure from upstream side, undergoes expansive deformation so as to open the outlet orifice

or the flow passage, and a vent hole that communicates with the flow passage which is provided at a position in the upstream of said valve element via an air filter, with the outlet orifice is defined as the downstream side wherein the expansive deformation of the valve element is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice or the flow passage cannot be achieved by the pressure required to pass air through the air filter from outside.

In the third delivery device, the valve element made of an elastic material and disposed in the outlet portion controls the closure and opening of the outlet orifice or the flow passage. When there is no liquid pressure exerted thereon from upstream side, the valve element closes the outlet orifice or the flow passage that communicates with the outlet orifice and, when forced by the liquid pressure from upstream side, undergoes expansive deformation and opens the outlet orifice or the flow passage. When the outlet orifice or the flow passage is opened, the flow passage between the upstream of the valve element and the outlet orifice is established to communicate, thus achieving delivery of the liquid from the outlet orifice.

In the third delivery device, delivery of the liquid from the outlet orifice may be achieved by applying a pressure to the container body that is connected with the delivery device as described previously. Such features and operations are also

similar to those described previously, that aseptic entry of air through the air filter into the container can be achieved when the valve element restores the original shape after the delivery operation, and that negative pressure that draws in the outside air accelerates the restoration of the deformed valve element (hence the valve element can be caused to act as a check valve).

In the third delivery device, since the expansive deformation of the valve element is achieved by a liquid pressure lower than the pressure that is required to pass the liquid through the air filter, there occurs no leakage of the liquid in the vent hole during delivery operation. Moreover, since the expansive deformation of the valve element is not caused by the pressure from outside according to its structure (hence the expansive deformation cannot be achieved by the pressure equal to air pressure to pass through the air filter from outside), there occurs no entry of the outside air through the outlet orifice, instead of the vent hole, nor corresponding leakage of the liquid through the outlet orifice during restoration of the container body.

As a result, according to the third delivery device of the present invention, delivery operation and restoration of the container after the delivery operation can be achieved smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust being carried by the liquid to the upstream.

In the third delivery device of the present invention, the

valve element has a valve body that is fixed in the flow passage and a projecting portion at the tip thereof on the outlet orifice side. The projecting portion at the tip of the valve body approaches from the upstream and engages a ridge formed on the inner wall of the flow passage that communicates with the outlet orifice so as to close the flow passage.

The valve body preferably expands toward the downstream under the effect of the liquid pressure from the upstream side, so as to form a clearance between the projecting portion at the tip of the valve body and the ridge provided on the inner surface of the flow passage.

In this case, when there is no liquid pressure exerted thereon, the projecting portion at the tip of the valve body engages with the ridge provided on the inner surface of the flow passage from the downstream side, so that the flow passage is closed. When the liquid pressure is applied, the valve element expands toward the downstream of the engaging position, thereby opening the clearance between the projecting portion at the tip of the valve body and the ridge provided on the inner surface of the flow passage. When the delivery operation is completed and the liquid pressure is removed from the valve element, the projecting portion at the tip of the valve body returns to the upstream as the valve element restores the original shape, so as to engage with the ridge provided on the inner surface of the flow passage again, thereby closing the flow passage. Restoration of the deformed valve element is

accelerated by the negative pressure, that is generated by the restoration of the container body which has been deformed by the delivery operation, and has the effect of drawing in the outside air as described above.

(Fourth Embodiment)

Fourth delivery device according to the present invention comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape that has an outlet orifice at the bottom thereof, a valve element made of an elastic material and disposed in contact with the outlet portion on the outer surface thereof that, when there is no liquid pressure exerted thereon from the upstream side, closes the outlet orifice and, when forced by the liquid pressure from the upstream side, undergoes expansive deformation so as to open the outlet orifice, with the outlet orifice side is defined as the downstream side and a vent hole that communicates with the outlet orifice via an air filter, wherein the expansive deformation of the valve element is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice cannot be achieved by the pressure required to pass air through the air filter from outside.

In the fourth delivery device, the valve element made of an elastic material and disposed in contact with the outlet portion on the outer surface thereof controls the closure and opening of the outlet orifice. When there is no liquid pressure exerted

thereon from the upstream side, the valve element closes the outlet orifice and, when forced by the liquid pressure from the upstream side, undergoes expansive deformation toward the outside (downstream side) of the outlet portion (thereby bending the valve element toward the outside) and opens the outlet orifice. When the outlet orifice is opened, the flow passage between the upstream side of the valve element and the outlet orifice is established to communicate with each other, thereby achieving delivery of the liquid from the outlet orifice.

In the fourth delivery device, delivery of the liquid from the outlet orifice may be achieved by applying a pressure to the container body that is connected with the delivery device as described previously. Such features and operations are also similar to those described previously, that aseptic entry of air through the air filter into the container can be achieved when the valve element restores the original shape after the delivery operation, and that negative pressure that draws in the outside air accelerates the restoration of the deformed valve element (hence the valve element can be caused to act as a check valve).

In the fourth delivery device, since expansive deformation of the valve element is achieved by a liquid pressure lower than the pressure that is required to pass the liquid through the air filter, there occurs no leakage of the liquid in the vent hole during the delivery operation. Moreover, since the expansive deformation of the valve element is not caused by the pressure

from outside according to its structure (hence the expansive deformation cannot be achieved by the pressure equal to air pressure to pass through the air filter from outside), there occurs no entry of the outside air through the outlet orifice, instead of the vent hole, nor corresponding leakage of the liquid through the outlet orifice during restoration of the container body.

As a result, according to the fourth delivery device of the present invention, delivery operation and restoration of the container body after the delivery operation can be achieved smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust being carried by the liquid to the upstream.

In the fourth delivery device of the present invention, the outlet orifice is defined by a substantially disk-shaped valve seat that is fixed in the outlet portion and the inner wall surface of the outlet portion that holds the valve seat, while the valve element has a substantially ring-shaped thin wall portion and closes the outlet orifice by bringing the thin wall portion into contact with the valve seat from the outer surface side of the outlet portion. The thin wall portion of the valve element preferably undergoes expansive deformation toward the downstream under the liquid pressure so as to open the outlet orifice, with the outlet orifice side being defined as the downstream.

In this case, when there is no liquid pressure exerted thereon,

the thin-walled portion of the valve element makes contact with the substantially disk-shaped valve seat so as to close the outlet orifice. When the liquid pressure is applied, the valve element undergoes expansive deformation toward the downstream (bending to the outside of the outlet portion), thereby opening the outlet orifice delimited between substantially disk-shaped valve seat and the inner wall surface of the outlet portion that holds the valve seat. When the delivery operation is completed and the liquid pressure is removed from the valve element, the thin-walled portion of the valve element again makes contact with the substantially disk-shaped valve seat so as to close the flow passage. Restoration of the deformed valve element is accelerated by the negative pressure that has the effect of drawing in the outside air and is generated by the restoration of the container body which has been deformed by the delivery operation, as described above.

In the fourth delivery device of the present invention, the valve element is preferably formed integrally on the outside of the outlet portion, which makes the process of manufacturing the delivery device more efficient. Methods for integrally forming the valve element and the outlet portion include multicolor molding and insert molding, though not limited to these methods.

(Fifth Embodiment)

Fifth delivery device according to the present invention comprises an outlet portion having substantially bottomed tubular shape or substantially bowl like shape that has an outlet orifice

at the bottom thereof, a valve element made of an elastic material having a substantially ring-shaped valve body and a substantially ring-shaped thin-walled portion disposed at the tip of the former, with the valve body being fixed in the outlet portion while the thin-walled portion is exposed through the orifice to the outside of the outlet portion, a valve support member of cylindrical shape that is disposed in the outlet portion and defines the outlet orifice together with the valve element, and a vent hole that communicates with a flow passage which is provided at a position in the upstream of said valve element via an air filter, wherein the thin-walled portion of the valve element makes contact with the periphery of the valve support member so as to close the outlet orifice when there is no liquid pressure exerted thereon from the upstream side, with the side of said outlet orifice defined as the downstream, and the thin-walled portion undergoes expansive deformation so as to open the outlet orifice when the liquid pressure is applied thereto from the upstream side, while the expansive deformation of the thin-walled portion is achieved by a liquid pressure lower than the pressure required to pass the liquid through the air filter and opening of the outlet orifice cannot be achieved by the pressure required to pass air through the air filter from outside.

In the fifth delivery device, the valve element made of an elastic material and disposed in the outlet portion has the thin-walled portion thereof being fixed in the state of being exposed through the orifice provided at the bottom of the outlet

portion to the outside of the outlet portion so as to define the outlet orifice between itself and the valve element support member. The thin-walled portion uses the cylindrical valve element support member as the valve seat so as to control the closure and opening of the outlet orifice. When there is no liquid pressure exerted thereon from the upstream side, the thin-walled portion of the valve element makes contact with the outer periphery of the valve element support member so as to close the outlet orifice. When the liquid pressure is applied thereto from the upstream side, the thin-walled portion undergoes expansive deformation toward the outside (downstream side) of the outlet portion and thereby opens the outlet orifice. When the outlet orifice is opened, the flow passage between the upstream of the valve element and the outlet orifice is established to communicate, thus achieving the delivery of liquid from the outlet orifice.

In the fifth delivery device, delivery of liquid from the outlet orifice may be achieved by applying a pressure to the container body that is connected with the delivery device as described previously. Such features and operations are also similar to those described previously, that aseptic entry of air through the air filter into the container can be achieved when the valve element restores the original shape after the delivery operation, and that negative pressure that draws in the outside air accelerates the restoration of the deformed valve element (hence the valve element can be caused to act as a check valve).

In the fifth delivery device, since expansive deformation of the valve element is achieved by a liquid pressure lower than the pressure that is required to pass the liquid through the air filter, there occurs no leakage of the liquid in the vent hole during the delivery operation. Moreover, since the expansive deformation of the valve element is not caused by the pressure from outside according to its structure (hence the expansive deformation cannot be achieved by the pressure equal to air pressure to pass through the air filter from outside), there occurs no entry of the outside air through the outlet orifice, instead of the vent hole, nor corresponding leakage of the liquid through the outlet orifice during restoration of the container body.

As a result, according to the fifth delivery device of the present invention, delivery operation and restoration of the container body after the delivery operation can be achieved smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust being carried by the liquid to the upstream.

In the fifth delivery device of the present invention, the valve element support member preferably has a flange on the upstream side of the cylindrical portion thereof so that, when there is no liquid pressure exerted thereon, the valve body of the valve element makes contact with the flange so as to close the flow passage and, when the liquid pressure is applied thereto, undergoes bending

deformation so as to open the flow passage between itself and the valve element support member.

In this case, when there is no liquid pressure exerted thereon from the upstream side, the thin-walled portion of the valve element not only makes contact with the outer periphery of the valve element support portion so as to close the outlet orifice, but also brings the valve body into contact with the flange of the valve element support member so as to close the flow passage. Therefore, it makes surer of closing of said outlet orifice. When the liquid pressure is applied from the upstream side, the valve element not only makes the thin-walled portion undergo expansive deformation toward the outside of the outlet portion (downstream) but also makes the valve body undergo compressive deformation, thereby to form (open) the flow passage between itself and the flange of the valve element support member. When the outlet orifice and the flow passage are opened as described above, the flow passage between the upstream of the valve element and the outlet orifice is established to communicate, thus achieving the delivery of liquid from the outlet orifice.

In the fifth delivery device and in preferred embodiment thereof, restoration of the deformed valve element, after completing the delivery operation with the liquid pressure removed, is accelerated by the negative pressure that is generated by the restoration of the container body which has been deformed by the delivery operation and draws in the outside air, as described above.

In the fifth delivery device of the present invention, the valve body of the valve element is preferably formed integrally on the inner surface of the outlet portion, which makes the process of manufacturing the delivery device more efficient. Methods for integrally forming the valve element and the outlet portion include, but not limited to, multicolor molding and insert molding.

[Antibacterial treatment]

In the delivery device of the present invention, the valve element and/or the outlet orifice is preferably subjected to antibacterial treatment. When the valve element and/or the outlet orifice is subjected to antibacterial treatment, effect of preventing the reproduction of bacteria can be achieved for the liquid remaining in the vicinity of the outlet orifice after completing the delivery operation.

Members subjected to antibacterial treatment may be chosen according to the constitution of the delivery device. Antibacterial treatment may be applied to various members such as, but not limited to, the entire outlet portion, the valve seat, the container body and the surface of a cap that covers the outlet portion (particularly the inner surface that touches the outlet portion), an water absorption material (sponge, cloth, paper, hydrogel, etc. provided to the inside of said cap.

Antibacterial treatment may be carried out by mixing a chemical such as an antiseptic or an antibacterial agent in the elastic material, such as thermoplastic elastomer that makes the

valve element, or in the resin material that makes the outlet portion, the outlet orifice, the valve seat, or in the raw material that makes the water absorption material or the like, coating the surface of the valve element, the outlet portion or the like that has been formed with the chemical, or applying surface treatment such as silane coupling or selenium coating to the material that is used to form the valve element, the outlet portion, the cap, the water absorption material in the cap or the like. Antibacterial treatment may be applied to hydrogel comprising a (meth) acrylamide polymer and water-swelling clay mineral by coating the surface thereof with selenium.

[Liquid Filter]

The delivery device of the present invention preferably has a liquid filter disposed in the upstream of the outlet orifice or in the upstream of the position of opening/closing the flow passage by the valve element. By providing the liquid filter, it is made possible to surely prevent or restrict the residual liquid from entering (flowing backward) the container body that is connected to the delivery device, should the residual liquid remaining around the outlet orifice of the outlet portion be contaminated by microorganism or dust. That is, it is preferable to provide the liquid filter in order to prevent or restrict contaminants from entering the container that is connected to the delivery device.

The liquid filter having fine mesh of about 0.2 to 0.45 μ

m makes it difficult to apply the delivery device of the present invention to a container that contains a suspension. On the other hand, this makes it possible to surely prevent or restrict the residual liquid from entering (flowing backward) the container body that is connected to the delivery device of the present invention, should the residual liquid contaminated by microorganism or dust flow back through the outlet orifice.

The liquid filter having coarse mesh of about 10 to 20 μm makes it possible to apply the delivery device of the present invention also to a container that contains a suspension. In this case, it is not necessary to take the loading of the liquid filter by the suspension into consideration, but rather such effects can be achieved as solvent in the container is prevented from evaporating and, as a result, suspended component can be prevented from precipitating near the outlet orifice. Also because even a liquid filter having such a coarse mesh is capable of suppressing the passage of microorganisms to some extent, it is made possible to restrict the residual liquid from entering the container body to some extent, should the residual liquid contaminated by microorganism or dust enter (flow back) through the outlet orifice.

[Container]

The container of the present invention for achieving the object described previously has the delivery device of the present invention fitted at the mouth of the container body. The container of the present invention is suited for use as an eye dropper

containing an ophthalmic solution.

BEST MODE FOR CARRYING OUT THE INVENTION

The delivery device of the present invention and the container provided therewith will now be described in detail below with reference to accompanying drawings.

[First Delivery Device and Container]

First delivery device 10 according to the present invention comprises an outlet portion 11 having substantially bottomed tubular shape (or substantially bowl like shape) that has an outlet orifice 12 at the bottom thereof, a valve element 13 disposed in the outlet portion 11 that, when there is no liquid pressure exerted thereon from the upstream side U, closes the outlet orifice 12 and, when forced by the liquid pressure from the upstream side U, undergoes compressive deformation and opens the outlet orifice 12, a locking member 14 that is disposed in the outlet portion 11 so as to define a flow passage 15 between itself and an inner surface 11d of the outlet portion and fastens the valve element 13 in the upstream side U, and a vent hole 16 that communicates with the flow passage which is provided at a position in the upstream of the valve element 13 via an air filter 17 as shown in Fig. 1.

The outlet orifice 12 is normally closed by the valve element 13 but, when a liquid pressure is applied to the valve element 13 from the upstream side U via the flow passage 15, the valve element 13 undergoes compressive deformation so that a clearance

is formed between the outlet orifice 12 of the outlet portion 11 and the valve element 13. This enables it to deliver the liquid contained in the container through the clearance.

The valve element 13 is fixed by the locking member 14 in the delivery device 10, and the clearance between the locking member 14 and the inner surface 11d of the outlet portion is the flow passage 15 for the liquid.

The outlet portion 11 comprises two members; an outlet portion body 11a that has the outlet orifice 12 and a linkage portion 11b that is disposed in the upstream side U of the outlet portion body 11a and is connected to the mouth of the container, because it is necessary to install the air filter 17 in the vent hole 16. The outlet portion body 11a and the linkage portion 11b are integrated using bonding means such as ultrasonic welding with the air filter 17 fitted in a joint 11c.

The first delivery device 10 is, for example, attached to the mouth of the container body 21 as shown in Fig. 2. In the case of the container 20 shown in Fig. 2, the delivery device 10 is attached to a neck 22 of the container 20 via a plug 23. The plug 23 is inserted slidably in the neck 22 of the container 20 as shown in Fig. 2 and Fig. 3. Fig. 2 is a sectional view of the container 20 in the state of being used, and Fig. 3 is a sectional view of the container 20 before unsealing.

In the state of being not yet unsealed as shown in Fig. 3, not only a cap 26 is attached to the outlet portion 11 but also

a stopper 27 is fitted between the delivery device 10 and the container body 21. Thus the delivery device 10 is lightly inserted in the container body 21. In this state, the tip portion 23a of the plug 23 is in contact with a flange 19 that is disposed on the inner surface of the delivery device 10. As a result, the flow passage 15 of the delivery device 10 is interrupted by the flange 19 and the tip portion 23a of the plug 23, thereby enabling it to maintain the liquid in the container body 21 at a high level of aseptic condition and prevent the deterioration (oxidization) of the liquid in the container from proceeding.

Sequence of delivery operations of the first delivery device of the present invention and the container provided therewith are shown in Fig. 4 and Fig. 5. Fig. 4(a) shows a state where pressure is not applied to the container body 21 and the valve element 13 of the delivery device closes the outlet orifice 12. As a result, the content liquid 24 of the container body 21 remains in the container body 21 and the delivery device without being delivered through the outlet portion 11. Fig. 4(b) shows a state of the container body 21 under a pressure applied thereto. In this state, the valve element 13 of the delivery device is under the pressure of the content liquid 24 from the upstream side U and accordingly undergoing compressive deformation of the valve element 13, so as to open the outlet orifice 12 thereby delivering the content liquid 24 in the form of a drop 25.

Fig. 5(a) shows a state that follows the state shown in Fig.

4(b). In this state, the pressure on the container body 21 is removed. In this state, since the valve element 13 of the delivery device does not receive the pressure of the liquid 24, the valve element 13 restores the original shape of the state without pressure, thereby closing the outlet orifice 12 again. Fig. 5(b) shows a state that follows the state shown in Fig. 5(a). In this state, the container body 21 is restoring the original shape of the state without pressure, as the pressure on the container body 21 is removed. In this state, since the valve element 13 of the delivery device closes the outlet orifice 12, outside air enters the container body 21 solely through the vent hole 16.

In another embodiment of first delivery device 10' and a container 20' provided therewith shown in Fig. 6, a liquid filter 18 is provided on the flow passage 15 that communicates with the outlet orifice 12. As a consequence, it is made possible to prevent or restrict the residual liquid from entering the container body 21 that is connected to the delivery device 10', should the residual liquid contaminated by microorganism or dust flow back from the outlet orifice 12, as described previously.

The first delivery device of the present invention may also be, for example, such that the valve elements 13a and 13b have sectional configurations shown in Fig. 7 and Fig. 8. That is, distal end of the valve elements 13 exposed through the outlet orifice 12 may be flat as in the delivery device 10a shown in Fig. 7, or the valve element 13b may have a recess 13c at the tip thereof

as in the delivery device 10b shown in Fig. 8. When liquid pressure is applied from the upstream side U, the valve element 13b having the configuration shown in Fig. 8 is more likely to undergo compressive deformation (and is therefore more likely to open the outlet orifice 12) than the valve element without recess 13c (the valve elements 13, 13a shown in Fig. 1 and Fig. 7, respectively). In addition, the valve element 13b is less prone to such a problem that the outlet orifice 12 is inadvertently opened by a pressure from outside of the outlet portion 11, and is therefore more advantageous for making the delivery operation smoother and preventing back flow.

[Second Delivery Device and Container]

Second delivery device 30 according to the present invention comprises, for example, an outlet portion 31 having substantially bottomed tubular shape having an outlet orifice 32 at the bottom thereof, a ring-shaped valve element 33 disposed in the outlet portion 31, a valve seat 34 that is fitted from an open end 31d side of the outlet portion 31 and makes contact with the valve element 33 on the upstream side U when the outlet orifice 32 is defined as the downstream side D, and a vent hole 36 that communicates with the flow passage 35 which is provided at a position in the upstream side U of the valve element 33 via an air filter 37, as shown in Fig. 9 (sectional view) and in Fig. 10 (exploded sectional view).

The outlet portion 31 consists of two members; an outlet

portion body 31a that has the outlet orifice 32 and a linkage portion 31b that is disposed in the upstream side U of the outlet portion body 31a and is connected to the mouth of the container, because it is necessary to install the air filter 37 in the vent hole 36. The outlet portion body 31a and the linkage member 31b are integrated using bonding means such as ultrasonic welding with the air filter 37 interposed by flange 31f (joint 31c) thereof.

In the delivery device 30 shown in Fig. 9 and Fig. 10, the integral assembly of the outlet portion body 31a and the valve element 33 is constituted by joining the ring-shaped valve element 33 with at least a part of the inner surface 31e of the outlet portion body 31a, as shown in the plan view in Fig. 11. The portions indicated with dashed lines with reference numeral 36 in Fig. 11(a) are vent holes covered with the air filter 37.

Fig. 11(b) is a bottom view of the integral assembly of the outlet portion body 31a and the valve element 33, wherein the outlet portion body 31a has a through hole (injection hole) 31g that penetrates the bottom thereof. The outlet portion body 31a may be formed, for example, by injecting a resin into a mold. The outlet portion body 31a and the valve element 33 may be integrally formed by replacing (or moving) the mold (movable mold) on the open end side 31d of the outlet portion 31 (refer to Fig. 10) after the injection described above, then injecting a thermoplastic elastomer through the injection hole 31g at the bottom of the outlet portion body 31a. The injection hole 31g becomes unnecessary when

integral molding of the valve element 33 is carried out by injecting the material through the open end side 31d of the outlet portion.

In the delivery device 30 shown in Fig. 9 and Fig. 10, the valve seat 34, that is fitted in the outlet portion body 31a from the upstream side U, has a tubular body 34c, which has a flange 34d, and a valve seat 34a disposed so as to block an opening on the opposite side of the flange 34d side of the tubular body 34c, as shown in the plan view (a) and the bottom view (b) of Fig. 12. Portion denoted with reference number 34b, together with a cavity of the ring-shaped valve element 33, delimits a flow passage 35 of liquid. Reference numeral 34e denotes a joint between the tubular body 34c and the valve seat 34a.

In the integrally molded body shown in Fig. 11(a), the valve element 33 has a ring shape. However, the valve element is not limited to a configuration that is continuous in the circumferential direction x of the outlet portion body 31a (ring-shaped), and may have such a configuration, for example, as shown in Fig. 13(a). In case the valve element has the configuration shown in Fig. 13(a), a flow passage (not shown) that is formed between the valve seat (not shown) and the outlet portion body 31a' by the compressive deformation of the valve element 33' becomes narrower than that of the case where the valve element 33 has a ring shape (Fig. 11). Therefore, shape of the valve element may be determined according to the width of the flow passage required by the delivery device. Reference numeral 31e' in Fig. 13(a)

denotes the inner surface of the outlet portion body 31a and 31f' denotes a flange of the outlet portion body 31a.

Fig. 13(b) shows a valve seat portion 34' used in a delivery device that has the valve element 33' of the shape shown in Fig. 13(a). The flow passage 35 of the valve seat portion 34' may be provided in accordance to the shape of valve element 33' of the delivery device shown in Fig. 13(a). Reference numeral 34a' in Fig. 13(b) denotes a valve seat.

The second delivery device 30 is used while being attached to the mouth of the container body 41, for example, as shown in Fig. 14.

Sequence of delivery operations of the second delivery device of the present invention and the container provided therewith are shown in Fig. 15 and Fig. 16. Fig. 15(a) shows a state where pressure is not applied to the container body 41 and the valve element 33 shuts off between the flow passage 35 on the outlet portion body 31a side and the passage 35 on the joint 31b side, thus shutting off the communication between the outlet orifice 32 and the container body 41. As a result, the content liquid 44 of the container body 41 remains in the container body 41 and in the delivery device 30 without being delivered through the outlet portion 31. Fig. 15(b) shows a state of the container body 41 under pressure applied thereto. In this state, the valve element 33 is under pressure of the liquid from the upstream side U via the flow passage 35, and accordingly undergoes compressive deformation. As a

result, a clearance is created between the valve element 33 and the valve seat 34a (namely the valve element is released) so that the flow passage 35 on the outlet portion body 31a side and the flow passage 35 on the joint 31b side communicate with each other. Thus the liquid 44 contained in the container body 41 is delivered from the outlet portion 31 in the form of a drop 45.

Fig. 16(a) shows a state that follows the state shown in Fig. 15(b), wherein the pressure on the container body 41 is removed. In this state, since the valve element 33 of the delivery device does not receive the pressure of the liquid 43, the valve element 33 restores the original shape of the state without pressure, thereby closing the clearance between the valve element 33 and the valve seat 34a. Fig. 16(b) shows a state that follows the state shown in Fig. 16(a), wherein the container body 41 is restoring the original shape of the state without pressure as the pressure on the container body 41 is removed. In this state, since the valve element 33 of the delivery device closes the flow passage 35, outside air enters the container body 41 solely through the vent hole 36.

As shown in Fig. 14 and Fig. 17, the plug 43 is inserted slidably in the neck 42 of the container 40. Fig. 14 shows a section of the container 40 in the state of being used, while Fig. 17 shows a section of the container 40 before being unsealed. In the state before being unsealed as shown in Fig. 17, the delivery device 30 is lightly inserted in the container body 41. In this state,

distal end 43a of the plug 43 is in contact with the flange 39 that is provided on the inner surface of the outlet portion 31. As a result, the flow passage 34 of the delivery device 30 is interrupted by the flange 39 and the distal end 43a of the plug 43, thereby enabling it to maintain the liquid in the container body 21 at a high level of aseptic condition and prevent the deterioration (oxidization) of the content liquid in the container from proceeding.

The delivery device 30 shown in Fig. 17 has a cap 46 screwed onto a screw portion 31h of the outlet portion body 31a, while a sponge 47 is disposed on the inner surface of the cap 46 at a position that makes contact with the outlet orifice 32 of the outlet portion 31. Since the sponge 47 absorbs the residual liquid 35' (refer to Fig. 16(b)) that remains in the outlet orifice 32 after completing the delivery operation, the residual liquid can be prevented from being supplied during the next delivery operation. Reference numeral 46a denotes a thread formed on the inner surface of the cap 46.

In the delivery device 30 shown in Fig. 17, the open end 46b of the cap blocks the vent hole 36 of the delivery device 30. As a result, such a problem is prevented from occurring as the solvent (water) or the like of the content liquid of the container body 41 gradually evaporates through the air filter 37, resulting in variation of the pH value of the content liquid.

The second delivery device is not limited to that described

above and, for example, may have such a configuration as shown in Fig. 18.

The delivery device 30' shown in Fig. 18 comprises, similarly to the delivery device 30 shown in Fig. 9, an outlet portion 31 having substantially bottomed tubular shape that has an outlet orifice 32 at the bottom thereof, a ring-shaped valve element 33' disposed in the outlet portion 31, a valve seat portion 34 that is fitted from an open end side of the outlet portion 31 and makes contact with the valve element 33' on the upstream side U when the outlet orifice 32 is defined as the downstream side D, a vent hole 36 that communicates with the flow passage 35 via the air filter 37 and a liquid filter 38 that is disposed in the upstream U of the valve seat portion 34 and covers the flow passage 35. The delivery device 30 is the same as the delivery device 10 shown in Fig. 9 except that shape of the valve element 31 and shape of the outlet portion 31 that houses the former near the outlet orifice 32 are different and the liquid filter 38 is provided in the flow passage 35.

[Third Delivery Device and Container]

Third delivery device 50 according to the present invention comprises, for example, an outlet portion 51 having substantially bottomed tubular shape that has an outlet orifice 52 at the bottom thereof, a valve element 53 made of an elastic material and disposed in an outlet portion 51 (a flow passage 55 that communicates with the outlet orifice 52) that when there is no liquid pressure exerted

thereon from the upstream side U, closes the outlet orifice 52 and when forced by the liquid pressure from the upstream side U, undergoes expansive deformation and opens the outlet orifice 52, and a vent hole 56 that communicates with the flow passage 55 which is provided at a position in the upstream side U of the valve element 53 via an air filter 57 as shown in Fig. 19 (sectional view) and Fig. 20 (exploded sectional view).

The outlet portion 51 comprises two members; an outlet portion body 51a that has the outlet orifice 52 and a linkage portion 51b that is disposed in the upstream side U of the outlet portion body 51a and is connected to the mouth of the container, because it is necessary to install the air filter 57 in the vent hole 56. The outlet portion body 51a and the linkage portion 51b are integrated using bonding means such as ultrasonic welding with the air filter 57 interposed by a flange 51f (joint 51c) thereof.

Fig. 21 is a plan view of the outlet portion body 51a (viewed from the upstream side U). As shown in this drawing, a ridge (valve seat) 52b for engaging with the projection of the valve body 53a is provided on the bottom of the outlet portion body 51a of the substantially tubular shape. Vent holes 56 are provided at predetermined intervals in the flange 51f (joint 51c) for installing the linkage portion 51b that makes a pair with the outlet portion body 51a, and the air filters 57 are installed in the vent holes 56 in order to achieve aseptic entry of air.

Fig. 22 shows the valve element 53 and a linkage with the

valve element support member 54 that locks the valve element, (a) of the drawing showing a plan view thereof (viewed from the upstream side U), and (b) showing a bottom view thereof (viewed from the downstream side D). As shown in this drawing, the valve element support member 54 that is used to place the valve element 53 in the outlet portion body 51a has a tubular member 54a, a locking member 54b that is disposed on the bottom of the former and locks the valve element 53, and a flange 54c that is disposed at the open end on the opposite side and engages the outlet portion body 51a.

As shown in Fig. 19 to Fig. 22, the valve element 53 is locked in the valve element support member 54 and is then fitted into the inner surface 51e of the outlet portion body 51a.

In case the valve element 53 is made of an elastic material that has thermoplastic property (such as thermoplastic elastomer), the valve element 53 and the valve element support member 54 may be formed integrally by multicolor molding or insert molding. This makes the manufacture of the two members in a simple way. In case the valve element 53 is made of an elastic material that is not thermoplastic and molding technology such as injection molding cannot be employed, the valve element 53 and the valve element support member 54 may be formed integrally, for example, by inserting the valve element support member 54 in an injection mold and then injecting the material to mold the valve element 53.

In the embodiment shown in Fig. 19, the valve element 53

comprises a valve body 53a that serves as a valve shaft, a projection 53b that is disposed at the tip of the valve element body 53a and serves as a valve head, and a flange 53c that engages the valve body 53a and the valve element support member.

The elastic member shown in Fig. 19 and Fig. 20 can be obtained, for example as shown in Fig. 23, by inserting the valve element support member 54 having the valve element 53 into the open end of the outlet portion body 51a (refer to reference 51d of Fig. 20) so as to place the projection 53b of the valve body 53a on the ridge 52b that is formed on the inner wall 52a of the flow passage of the outlet portion 52, then applying a strong pressure of liquid or air from the upstream side U and sliding the projection 53b of the valve body toward the outlet orifice 52 side.

The first delivery device 50 is used while being attached to the mouth of the container body 61, for example, as shown in Fig. 24. The container 60 shown in Fig. 24 has a plug 63 mounted in a neck 62 of the container body 61.

Sequence of delivery operations of the second delivery device of the present invention and the container provided with the same are shown in Fig. 25 and Fig. 26. Fig. 25(a) shows a state where pressure is not applied to the container body 61. In this state, the valve element 53 interrupts the communication between the flow passage 55 in the outlet orifice 52 and the flow passage 55 on the upstream side of the valve element 53, thus shutting off the communication between the outlet orifice 52 and the container body

61. As a result, the content liquid 64 of the container body 61 remains in the container body 61 and in the delivery device 50 without being delivered through the outlet portion 51. Fig. 25(b) shows a state of the container body 61 under a pressure applied thereto. In this state, the valve element 53 is under pressure of the liquid from the upstream side U via the flow passage 55, and accordingly undergoing expansive deformation toward the outlet orifice 52 side. As a result, the projection 53b of the valve body 53a and the ridge 52b formed on the inner wall 52a of the outlet portion 52 communicate with each other, so that the liquid 64 contained in the container body 61 is delivered from the outlet portion 51 in the form of a drop 65.

Fig. 26(a) shows a state that follows the state shown in Fig. 25(b), wherein the pressure on the container body 61 is removed. In this state, since the valve element 53 of the delivery device does not receive the pressure of the content liquid 64, the valve element 53 restores the original shape of the state without pressure thereby closing the clearance between the valve element 53 and the ridge 52b. Fig. 26(b) shows a state that follows the state shown in Fig. 26(a), wherein the container body 61 is restoring the original shape of the state without pressure as the pressure on the container body 61 is removed. In this state, since the valve element 53 of the delivery device closes the flow passage 55 at the position of the ridge 52b of the outlet portion, outside air enters the container body 61 solely through the vent hole 56.

As shown in Fig. 24 and Fig. 27, the plug 63 is inserted slidably in the neck 62 of the container 60. The function of the plug 23 is similar to that of the container 40 that is provided with the second delivery device 30. Fig. 24 shows a section of the container 60 in the state of being used, while Fig. 27 shows a section of the container 60 before being unsealed. In Fig. 27, reference numeral 63a shows distal end of the plug 63, and reference numeral 59 shows the flange provided on the inner surface of the outlet portion 51.

The delivery device 51 shown in Fig. 27 has a cap 66 screwed onto a projecting portion 51h of the outlet portion body 51a, while a sponge 67 is disposed on the inner surface of the cap 66 at a position that makes contact with the outlet orifice 52 of the outlet portion 51. The open end 66b of the cap blocks the vent hole 56. The sponge 67 and the open end 66b exhibit the similar function to that o the container 40 that is provided with the second delivery device 30. Reference numeral 66a denotes a thread that is formed on the inner surface of the cap 66.

[Fourth Delivery Device and Container]

Fourth delivery device 70 according to the present invention comprises, for example as shown in Fig. 28, an outlet portion 71 having substantially bottomed tubular shape that has an outlet orifice 72 at the bottom thereof, a valve element 73 made of an elastic material that when there is no liquid pressure exerted thereon from the upstream side U, closes the outlet orifice 72

from the outside of the outlet portion 71 and makes contact with a valve seat 74, and when there is a liquid pressure from the upstream side U, undergoes expansive deformation so as to open an outlet orifice 72, and a vent hole 76 that communicates with the flow passage which is provided to a position in the upstream of a valve element 73 via an air filter 77.

The outlet portion 71 comprises two members; an outlet portion body 71a that has the outlet orifice 72 and a linkage portion 71b that is disposed in the upstream side U of the outlet portion body 71a and is connected to the mouth of the container, because it is necessary to install the air filter 77 in the vent hole 76, similarly to the first delivery device described above. The outlet portion body 71a and the linkage portion 71b are integrated using bonding means such as ultrasonic welding, with the air filter 77 being interposed by a flange 71f (joint 71c).

Fig. 29(a) is a bottom view of the outlet portion body 71a (viewed from the downstream side D), and (b) of the drawing is a sectional view taken along lines A-A of Fig. 28. The outlet portion body 71a has a plurality of vent holes 76 and air filters 77 that fill the holes, similar to those shown in Fig. 21, in the flange 71f (joint 71c) that is used to install the linkage portion 71b that makes a pair with the outlet portion body 71a. Functions of the air filters 77 and the vent holes 76 are similar to the case of the container 60 that is provided with the third delivery device 50.

As shown in Fig. 28 to Fig. 29, the valve element 73 is disposed in contact with both the outer surface of the bottom of the outlet portion body 71a having substantially bottomed tubular shape or substantially bowl like shape having an outlet orifice at the bottom thereof, and the bottom surface (outer surface) of the valve seat 74 that defines the flow passage 75 at the bottom of the outlet portion body 71a and closes the outlet portion. The valve element 73 is preferably formed from an elastic material having thermoplasticity integrally with the outlet portion body 71a on the outer surface of the outlet portion body 71a that is made of a resin. Integral forming makes the manufacturing process for the delivery device 70 simpler.

The fourth delivery device 70 is used while being attached to the mouth of the container body 81, for example, as shown in Fig. 30(a). The container 80 shown in Fig. 30(a) has an inner plug 83 provided in neck 82 of the container body 81. The function of the plug 83 is similar to that of the container 40 that is provided with the second delivery device 30 or that of the container 60 that is provided with the third delivery device 50.

Sequence of delivery operations of the delivery device of the present invention and the container provided therewith are shown in Fig. 30 and Fig. 31. Fig. 30(a) shows a state where pressure is not applied to the container body 81. In this state, the valve element 73 shuts off the flow passage 75 in the outlet orifice 72, thus shutting off the communication between the outside of

the outlet orifice 72 and the container body 81. As a result, the content liquid 84 of the container body 81 remains in the container body 81 and in the delivery device 70 without being delivered through the outlet portion 71. Fig. 30(b) shows a state of the container body 81 under a pressure applied thereto. In this state, the valve element 73 is under pressure of the liquid applied from the upstream side U via the flow passage 75, and accordingly undergoing expansive deformation toward the outlet orifice 72 side. As a result, a flow passage is formed between the valve element 73 and the valve seat portion 74, so that the liquid 84 contained in the container body 81 is delivered from the outlet portion 71 in the form of a drop 85.

Fig. 31(a) shows a state that follows the state shown in Fig. 30(b), wherein the pressure on the container body 81 is removed. In this state, since the valve element 73 of the delivery device does not receive the pressure of the liquid 84, the valve element 73 restores the original shape of the state without pressure thereby closing the clearance between the valve element 73 and the valve seat 74. Fig. 31(b) shows a state that follows the state shown in Fig. 31(a), wherein the container body 81 is restoring the original shape of the state without pressure as the pressure on the container body 81 is removed. In this state, since the valve element 73 of the delivery device closes the flow passage 75 between the valve element 73 and the valve seat 74 of the outlet portion 71a, outside air enters the container body 81 solely through the

vent hole 76.

Delivery device 70' shown in Fig. 32 is another embodiment of the fourth delivery device. In case the valve element is made of an elastic material that has thermoplastic property, the valve element 73 and the outlet portion body 71a may be integrally formed, similarly to the delivery device 70 shown in Fig. 28. The valve element 73 may be formed from an elastic material other than thermoplastic elastomer, such as rubber that is not thermoplastic, as long as the material is pliant and easily undergoes bending deformation by liquid pressure. In case the valve element is made of an elastic material that is not thermoplastic and therefore molding technology such as injection molding cannot be employed, the valve element 73' may be interposed between the outlet portion body 71a' and the valve seat 74 (and tubular body 74a) and disposed in the outlet portion 71 as in the embodiment shown in Fig. 32, for example.

The delivery device 70' shown in Fig. 32 is similar to the delivery device 70 shown in Fig. 28 except that the outlet portion body 71a' and the valve element 73' are different.

[Fifth Delivery Device and Container]

Fifth delivery device 90 according to the present invention comprises, for example as shown in Fig. 33, a substantially bottomed tubular outlet portion 91 that has a hole 91d at the bottom thereof, a valve element 93 that has a substantially ring-shaped valve body 93b and a substantially ring-shaped thin wall portion 93a which

continues with the former and is constituted by fixing the valve body 93b in the outlet portion 91 with the thin wall portion 93a being exposed through the hole 91d to the outside of the outlet portion 91, a valve element support member 94a of cylindrical shape that is disposed in the outlet portion 91 and delimits the outlet orifice 92 together with the valve element 93, and a vent hole 96 that communicates with the flow passage 95 which is provided at a position in the upstream U of the valve element 93 via an air filter 97.

The outlet orifice 92 is normally closed by the thin wall portion 93a of the valve element 93 but, when pressure of the liquid is applied to the valve element 93 from the upstream via the flow passage 95, the thin wall portion 93a undergoes expansive deformation so as to create a clearance between the thin wall portion 93a and the valve element support member 94a, thereby delivering the content liquid through the clearance.

In the embodiment shown in Fig. 33, the valve element 93 is fixed on the inner surface of the outlet portion body 91a with the thin wall portion 93a being exposed through the hole 91d of the outlet portion 91 (outlet portion body 91a). In Fig. 33, reference numeral 94c denotes a tubular member that holds the valve element support member 94a and the flange 94b so as to fasten the valve element support member 94 in the outlet portion 91 (outlet portion body 91a). It is good enough that the valve body 93b has the thickness enough to be integrally formed on the inner surface

of the outlet portion body 91a.

The outlet portion 91 comprises two members; the outlet portion body 91a that has the outlet orifice 92 and a linkage portion 91b that is disposed in the upstream side U of the outlet portion body 91a and is connected to the mouth of the container, because it is necessary to install the air filter 97 in the vent hole 96. The outlet portion body 91a and the linkage portion 91b are integrated using bonding means such as ultrasonic welding with the air filter 97 interposed by the joint 91c.

The fifth delivery device 90 is used while being attached to the mouth of the container body 101, for example, as shown in Fig. 34.

Sequence of delivery operations of the fifth delivery device 90 of the present invention and the container 100 provided with the same are shown in Fig. 36 and Fig. 37. Fig. 36(a) shows a state where pressure is not applied to the container body 101. In this state, the valve element 93 of the delivery device closes the outlet orifice 92. As a result, the content liquid 104 of the container body 101 remains in the container body 101 and in the delivery device without being delivered through the outlet portion 91. Fig. 36(b) shows a state of the container body 101 under a pressure applied thereto. In this state, the valve element 93 is under pressure of the content liquid 104 from the upstream U and is accordingly undergoing expansive deformation so that the outlet orifice 92 is opened and the content liquid 104 is delivered

in the form of a drop 105. Fig. 38 is an enlarged view of the outlet portion 91 in the state shown in Fig. 36(b).

Fig. 37(a) shows a state that follows the state shown in Fig. 36(b), wherein the pressure on the container body 101 is removed. In this state, since the valve element 93 of the delivery device does not receive the pressure of the liquid 104, the valve element 93 restores the original shape of the state without pressure thereby closing the outlet orifice 92 again. Fig. 37(b) shows a state that follows the state shown in Fig. 37(a), wherein the container body 101 is restoring the original shape of the state without pressure as the pressure on the container body 101 is removed. In this state, since the valve element 93 of the delivery device closes the outlet orifice 92, outside air enters the container body 101 solely through the vent hole 96.

In the container 100 shown in Fig. 34, the delivery device 90 is attached to the neck 102 of the container 100 via a plug 103. The plug 103 is inserted slidably in the neck 102 of the container 100. Fig. 34 is a sectional view of the container 100 in the state of being used. The state of the distal end 103a of the plug 103 and the flange 99 being engaged with each other (namely the seal is not yet broken) and the effect of the engagement of the two members are similar to those of the other embodiments shown in Fig. 3, Fig. 17 and Fig. 27.

The delivery device 90 shown in Fig. 35 has a cap 106 screwed onto the outer surface of the outlet portion body 91a. The cap

106 has a recess 108 formed at a position corresponding to the outlet orifice 92 in the state of being screwed onto the outlet portion body 91a. Inner surface of the cap 106 and the outlet orifice 92 makes contact with each other in the recess 108. A sponge 107 is disposed around the recess 108 so that the residual liquid 105' (refer to Fig. 37(b)) remaining in the outlet orifice 92 is squeezed out by the inner surface of the cap at the recess 108, and is absorbed by the sponge 107.

In the delivery device 90 shown in Fig. 35(a), the open end 106b of the cap blocks the vent hole 96 of the delivery device 90. As a result, such a problem is prevented from occurring as the solvent (water) or the like of the content liquid of the container body 101 gradually evaporates through the air filter 97, resulting in variation of the pH value of the content liquid.

In another embodiment of the fifth delivery device 90' shown in Fig. 39, closure of the flow passage 95 is achieved not only by the contact of the thin-walled portion 93a and the valve element support member 94a but also by the contact of the valve element support member 94 and the flange 94b. As a result, closure of the flow passage 95 by the valve element 93' can be reliably achieved, while preventing, at a high level, the backflow of the residual liquid containing microorganisms and dust that has been delivered from the outlet orifice 92. Fig. 40 is an enlarged view of the outlet portion 91 of the delivery device 90' in the state shown in Fig. 38.

In the fifth delivery device 90, 90', a liquid filter (not shown) may be provided in the upstream of the position where the flow passage 95 is opened and closed (position of contact between the thin-walled portion 93a and the valve element support member 94a, position of contact between the valve body 93b' and the flange 94b). The effect of providing the liquid filter is similar to the case of other embodiment shown in Fig. 6 and Fig. 18.

In the container 100 provided with the fifth delivery device, in case the container is used to contain ophthalmic solution for such an application as to deliver a drop of the liquid of about 20 to 40 μL per one delivery operation, outer diameter of the valve element support member 94a is set in a range from 0.6 to 2.0 mm, and preferably in a range from 1.0 to 1.2 mm. The thickness of the thin-walled portion 93a of the valve element 93 is set in a range from 0.8 to 2.5 mm, and preferably in a range from 0.8 to 1.5 mm.

In order to prevent leakage of the liquid from the outlet orifice 92, the thin-walled portion 93a of the valve element is preferably somewhat expanded by the valve element support member 94a. Therefore, inner diameter of the thin-walled portion 93a without the valve element support member 94a inserted therethrough is preferably made slightly smaller than the outer diameter of the valve element support member 94a. For example, inner diameter of thin-walled portion 93a is preferably adjusted to a range from 50 to 99 % to outer diameter of the valve element support member

94a and more preferably to a range from 50 to 90 %, and further more preferably to 60 to 80 %. In such the delivery device 90' as shown in Fig. 39, that closure of the flow passage 95 is achieved not only by the contact of the thin-walled portion 93a of the valve body 93 and the valve element support member 94a but also by the contact of the valve body 93b' and the flange 94b of the valve element support member 94, greater effect of preventing leakage of the liquid from the outlet orifice 92 is achieved and therefore the inner diameter of the thin-walled portion 93a can be designed with less demanding requirement than in the case described above.

Now members of the delivery device of the present invention and the container provided with the same will be described in detail below.

(Valve Element)

The valve element in the delivery device of the present invention is required to be such that compression or expansion deformation is easily achieved by a liquid pressure applied from the container body side that is lower than the pressure required to pass the liquid through the air filter, and compression or expansion deformation cannot be achieved by an air pressure required to pass air through the air filter from outside. Materials that can be used for the valve element include thermoplastic elastomer of low hardness; gel-like material; and rubber such as natural rubber, silicone rubber, isoprene rubber, butyl rubber, butadiene rubber and fluororubber.

While there is no limitation to the kind of material, hardness of the valve element is required to be in a range from 0 to 40 in terms of JIS A hardness (spring hardness Hs (type A) measured according to a method specified in JIS K 6301-5.2 "Spring hardness test", in order to have the characteristics described above concerning expansive deformation or compression deformation. Within the range described above, hardness (JIS A) of the valve element is preferably not higher than 30, more preferably within 20, and further more preferably within 10. While the lower limit of hardness (JIS A) of the valve element is not restricted further than the range described above, the value may be 2 or higher in terms of JIS A in view of the material availability, strength of the valve element and other factors.

Specific examples of the material of the valve element include the followings. Examples of the thermoplastic elastomer include modified SEBS copolymers such as styrene-ethylene/butylene-styrene block copolymer (SEBS), styrene-butadiene-styrene block copolymer (SBS), styrene-isoprene-styrene block copolymer (SIS) and modified maleic acid; styrene elastomers such as styrene-ethylene/propylene-styrene block copolymer (SEPS), styrene-ethylene/butylene block copolymer (SEB) and styrene-ethylene/propylene block copolymer (SEP); olefin elastomers such as ethylene-propylene block copolymer; polyurethane elastomers; and mixtures thereof. Among

thermoplastic styrene elastomers, "Septone® compound" manufactured by KURARAY PLASTICS CO., LTD. is preferable.

Examples of the gel-like material include gel comprising a straight-chain hydrocarbon polymer (olefin elastomer) [for example, "Cosmo-gel" manufactured by Cosmo Instrument Co., Ltd.]; and silicone-urethane gel ["Chemitek gel" (trade name) manufactured by Chemitek Co.].

The elastic material that forms the valve element may be a foamed material (of which voids are separated from each other so as not be permeable to liquid), or may be a material of which hardness is adjusted within the range described above by means of an additive.

Deformability of the valve element under liquid pressure can be measured, besides hardness, by tensile strength and modulus of compressive elasticity of the elastic material. The elastic material that forms the valve element preferably has permanent strain ratio CS (measured at 70℃ for 22 hours per JIS K 7301) not higher than 50, so as not to break after repetitive cycles of loading and unloading with the liquid pressure. In case the delivery device is used at an outlet portion of eye dropper, considering that the dripping rate of the ophthalmic solution is generally around 0.05 mL/second, a pressure which is required to cause the valve element to undergo compressive or expansive deformation is preferably from 0.01 to 0.2 Mpa.

When the valve element 33, 33′ is fixed on the inner surface

(31e) of the outlet portion 31 as in the delivery device 30, 30' shown in Fig. 9 and Fig. 18, the valve element 33, 33' and the outlet portion body 31a may be integrally formed from a thermoplastic material selected from among the elastic materials listed above.

In case the valve element is attached to the outlet orifice 72 of the outlet portion body 71a as in the delivery device 70 shown in Fig. 28, the valve element 73 and the outlet portion body 71a may be integrally formed from a thermoplastic material selected from among the elastic materials listed above.

In case the valve element is disposed in the outlet portion 70' by interposing between the outlet portion body 71a' and the tubular body 74a that is provided to join with the valve seat 74 as in the case of the delivery device 70' shown in Fig. 32, the elastic material that forms the valve element is not limited to thermoplastic materials.

(Air Filter)

The air filter used in the present invention is required to pass liquid under a pressure higher than the pressure that causes the valve element of the delivery device to undergo two types of deformation, compressive and expansive deformation, and the pressure required to pass air from outside is lower than the pressure that opens the outlet orifice.

Since the pressure that causes the valve element of the delivery device to undergo two types of deformation, compressive

and expansive deformation, so as to deliver the content liquid varies depending on the speed of the delivery operation (dripping rate of the delivered liquid drop), liquid passing pressure and air passing pressure of the air filter must also be set according to the application of the delivery device and the expected speed of the delivery operation.

The dripping rate of the ophthalmic solution is generally around 0.05 mL/second which requires a pressure from 0.01 to 0.2 MPa to cause the valve element to undergo compressive or/and expansive deformation thereby to drip the ophthalmic solution. Therefore, in case the delivery device is used for eye dropper, liquid passing pressure of the air filter of 0.01 MPa or higher, preferably 0.2 MPa or higher makes it possible to prevent the ophthalmic solution from leaking through the vent hole when instillating the ophthalmic solution.

The rate of filling the depressed eye dropper with air (air intake rate) after instillating the ophthalmic solution is generally from 1 to 10 mL/second. An air filter having air passing pressure lower than 0.005 MPa, preferably lower than 0.001 MPa, can achieve smooth intake of outside air through the vent hole.

Mesh size of the air filter is determined so as to allow the passage of only air while blocking the liquid delivered by the delivery device of the present invention (the liquid contained in the container of the present invention), microorganisms such as bacteria and dust carried by air, and is usually set in a range

from 0.1 to 0.45 μm, preferably about 0.1 μm.

The air filter that can be used in the present invention include, but not limited to, those made of hydrophobic polytetrafluoroethylene (PTFE) film manufactured by GORE-TEX Japan Inc. and Sure Vent Durapore® (polyvinylidene fluoride (PVDF)) manufactured by Nihon Millipore Corporation.

(Liquid Filter)

The liquid filter used in the present invention passes a liquid when a pressure not less than a certain level is applied. When such a liquid filter is installed in the upstream of the outlet orifice, it is made possible to prevent the residual liquid from entering the container body that is connected to the delivery device, should the residual liquid remaining around the outlet orifice flow back upstream.

The liquid filter that can be used in the present invention include, but not limited to, those made of hydrophilic PTFE film manufactured by GORE-TEX Japan Inc., hydrophilic Durapore® (made of PVDF) and hydrophilic polyether sulfonate (PES) manufactured by Nihon Millipore Corporation.

[Cap]

In the delivery device of the present invention, antibacterial treatment may be applied to the cap that covers the outer surface of the outlet portion in addition to, or instead of, the outlet orifice. Portions of the cap to which antibacterial treatment is applied are, but not limited to, part of the inner

surface thereof that makes contact with the outlet orifice and the sponge disposed in the cap.

Since backflow of the liquid from the outlet orifice to the upstream does not occur in the delivery device of the present invention, residual liquid remaining after completing the delivery operation remain around the outlet orifice without returning into the outlet portion. Therefore, the residual liquid can be prevented from being supplied during the next delivery operation by using a cap provided with an absorbing material provided therein and having the sponge absorb the residual liquid remaining around the outlet orifice after completing the delivery operation (refer to Fig. 17 and Fig. 27).

When antibacterial treatment is applied to the sponge which is then brought into contact with the outlet orifice, antibacterial agent may leach from the sponge and accumulate on the outlet orifice. To avoid this problem, such a design may be employed as the residual liquid squeezed by the inner surface of the cap is absorbed by an absorbing material provided on the periphery of the inner surface of the cap (Fig. 35), avoiding the direct contact of the sponge and the outlet orifice.

Absorbing materials include for example sponges made of such material as urethane or foamed polyethylene; clothes made of non-woven fabric cloth, absorbent cotton or gauze, etc.; papers or hydrogels. The sponge may be made of a material known in the prior art such as urethane and foamed polyethylene. Antibacterial

treatment to the sponge is preferable to coat the surface of the sponge that has been formed with the antibacterial agent, or to mix the antibacterial agent in urethane or polyethylene before forming it into the sponge. Further, an absorbing material having antibacterial activity may be used.

Antibacterial treatments applied to the cloth, paper, hydrogel, etc. include, for example, silane coupling or selenium coating. Examples of hydrogels include a mixture of (meth)acrylamide polymer and water-swelling clay mineral (see Japanese published unexamined Patent Application (Kokai Tokkyo Koho) NO.2002-53629, Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No.2002-53762, etc.), and so on.

(Materials to form Delivery Device, Cap and Container Body)

The delivery device, the cap and the container body may be formed from a resin such as polyethylene (PE) or polypropylene (PP). PE and PP, in particular, are materials that can be safely used in pharmaceutical applications, and are preferably used in case the container of the present invention contains liquid medication such as ophthalmic solution.

The resin used to form the delivery device, the cap and the container body may be mixed with an antiseptic or the like in advance, in order to improve the effect of preventing the residual liquid remaining around the outlet orifice after completing the delivery operation and the liquid in the container from degenerating. As the antiseptic, ammonium salt of class 4, such as "Dimer 38®" and

"Dimer 136®" manufactured by Inui Corporation may be used.

The delivery device, the cap and the container body may also be coated with the antiseptic after being formed, or surface treatment such as silane coupling may be applied when forming the delivery device, the cap and the container body. The resin material having antibacterial activity may be used to form an outlet portion, and so on.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing an embodiment of the first delivery device.

Fig. 2 is a sectional view showing an embodiment of the container provided with the first delivery device.

Fig. 3 is a sectional view showing the container shown in Fig. 2 in the state of being not unsealed.

Fig. 4 is a sectional view showing the container shown in Fig. 2 in the state of being used.

Fig. 5 is a sectional view showing the state following the state shown in Fig. 4.

Fig. 6 is a sectional view showing another embodiment of the container provided with the first delivery device.

Fig. 7 is a sectional view showing another embodiment of the first delivery device.

Fig. 8 is a sectional view showing further another embodiment of the first delivery device.

Fig. 9 is a sectional view showing an embodiment of the second delivery device.

Fig. 10 is an exploded sectional view showing the delivery device 30 shown in Fig. 9.

Fig. 11(a) is a plan view showing an example of the outlet portion body 31a and the valve element 33 being integrally formed, and Fig. 11(b) is a bottom view thereof.

Fig. 12(a) is a plan view of the valve seat portion 34, and Fig. 12(b) is a bottom view thereof.

Fig. 13(a) is a plan view showing another example of the outlet portion body and the valve element being integrally formed, and Fig. 13(b) is a plan view showing another example of the valve seat portion.

Fig. 14 is a sectional view showing an embodiment of the container provided with the second delivery device.

Fig. 15 is a sectional view showing the container of Fig. 14 in the state of being used.

Fig. 16 is a sectional view showing the state following the state shown in Fig. 15.

Fig. 17 is a sectional view showing the container 40 shown in Fig. 14 in the state of being not unsealed.

Fig. 18 is a sectional view showing another embodiment of the second delivery device.

Fig. 19 is a sectional view showing an embodiment of the third delivery device.

Fig. 20 is an exploded sectional view of the delivery device 50 shown in Fig. 19.

Fig. 21 is a plan view of the outlet portion body 51a shown in Fig. 20.

Fig. 22(a) is a plan view of the valve element support member 54 shown in Fig. 20, and Fig. 22(b) is a bottom view thereof.

Fig. 23 is an explanatory diagram showing the procedure of assembling the delivery device 50 shown in Fig. 19.

Fig. 24 is a sectional view showing an example of container provided with the delivery device 50 shown in Fig. 19.

Fig. 25 is a sectional view showing the container 60 shown in Fig. 24 in the state of being used.

Fig. 26 is a sectional view showing the state following the state shown in Fig. 25.

Fig. 27 is a sectional view showing the container 60 shown in Fig. 24 in the state of being not unsealed.

Fig. 28 is a sectional view showing an embodiment of the fourth delivery device.

Fig. 29(a) is a bottom view of the delivery device 70 shown in Fig. 28, and Fig. 29(b) is a sectional view taken along lines A-A.

Fig. 30(a) is a sectional view showing an example of container provided with the fourth delivery device 70 and Fig. 30(b) is a sectional view showing the state of use thereof.

Fig. 31 is a sectional view showing the state following the

state shown in Fig. 30(b).

Fig. 32 is a sectional view showing another embodiment of the fourth delivery device.

Fig. 33 is a sectional view showing an embodiment of the fifth delivery device.

Fig. 34 is a sectional view showing an embodiment of the container provided with the fifth delivery device.

Fig. 35(a) is a sectional view showing the container 100 shown in Fig. 34 fitted with the cap, and Fig. 35(b) is a sectional view of the cap.

Fig. 36 is a sectional view showing the container of Fig. 34 in the state of being used.

Fig. 37 is a sectional view showing the state following the state shown in Fig. 36.

Fig. 38 is an enlarged sectional view showing the outlet portion of the container 100 shown in Fig. 36(b).

Fig. 39 is a sectional view showing another embodiment of the fifth delivery device.

Fig. 40 is an enlarged sectional view showing the outlet portion of the container 100' shown in Fig. 39 during use.

Fig. 41(a) is a front view showing an example of an eye dropper of the prior art, and Fig. 41(b) is an enlarged sectional view of the delivery device thereof.

Fig. 42 is an explanatory diagram showing problem of the eye dropper of the prior art.

[DESCRIPTION OF REFERENCE NUMERALS]

10, 10', 10a, 10b, 30, 30', 50, 70, 70', 90, 90': Delivery device

11, 31, 51, 71, 71', 91: Outlet portion

11d: Inner surface of outlet portion

12, 32, 52, 72, 92: Outlet orifice

13, 13a, 13b, 33, 33', 53, 73, 73', 93, 93': Valve element

14: Locking member

15, 35, 55, 75, 95: Flow passage

16, 36, 56, 76, 96: Vent hole

17, 37, 57, 77, 97: Air filter

18, 38, 58, 78: Liquid filter

20, 20', 40, 60, 80, 100: Container (Eye dropper)

21, 41, 61, 81, 101: Container body

23, 43, 63, 83, 103: Plug

24, 44, 64, 84, 104: Content liquid

25, 45, 65, 85, 105: Liquid drop

25', 45', 65', 85', 105': Residual liquid

26, 46, 66, 106: Cap

34a, 34a', 74: Valve seat

52a: Flow passage inner wall

52b: Ridge

53a: Valve body

53b: Projection

93a: Thin-walled portion

93b: Valve body

94a: Valve element support member

94b: Flange

U: Upstream side

D: Downstream side

INDUSTRIAL APPLICABILITY

The delivery device of the present invention enables it to achieve delivery operation and restoration of the container body after the delivery operation smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust carried by the liquid to the upstream.

In the delivery device of the present invention, since deformation of the valve element is achieved with a pressure lower than the liquid passing pressure of the air filter, delivery through the outlet orifice can be achieved reliably without leakage of the liquid through the vent hole during delivery operation. Moreover, since opening of the outlet orifice and/or a flow passage communicating with the outlet orifice is not achieved with the air passing pressure of the air filter from outside, such problems do not occur as the outside air enters through the outlet orifice instead of the vent hole during restoration of the container body, nor corresponding leakage of the liquid through the outlet orifice. As a result, the delivery device of the present invention enables

it to achieve delivery operation and restoration of the container body after the delivery operation smoothly while preventing, at a high level, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust carried by the liquid to the upstream.

The delivery device of the present invention does not employ a porous filter disposed in the outlet portion according to the antibacterial container disclosed in Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2001-179017 and Japanese Published Unexamined Patent Application (Kokai Tokkyo Koho) No. 2001-206454. Therefore, the possibility of the outlet orifice being clogged is very low even when the content liquid is a suspension. The outlet orifice will not be clogged if the size of the suspended particles is about 50 μm or less, depending on the size and material of the valve element and outlet orifice.

The container of the present invention has the delivery device of the present invention fitted at the mouth thereof. As a result, the backflow of the liquid that has been delivered from the outlet orifice and the entry of microorganisms and dust carried by the liquid to the upstream can be prevented at a high level. Therefore, it is made possible to eliminate or reduce the use of antiseptic agent for the purpose of preventing the liquid from degenerate or deteriorate. Also because the container of the present invention does not employ a porous filter at the outlet portion thereof, the outlet orifice will not be clogged and

therefore smooth delivery of the liquid can be achieved even when the content liquid is a suspension, except for a case where the liquid filter is disposed at the upstream side of the outlet orifice.

The container of the present invention also preferably has the plug that is held slidably in the flow passage of the delivery device or in the container body, so that the plug makes contact with the inner wall of the flow passage of the delivery device and close the flow passage when the container is not being used. This constitution ensures that the content liquid is kept in aseptic condition in airtight configuration until the container is put into use. Also because the liquid can be kept from making contact with the valve element and air filter before being put in use, stable quality can be maintained for a long period of time. The container of the present invention is suited for use as an eye dropper containing an ophthalmic solution.